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Structuring Ideation Map using Oriented Directed Acyclic Graph with Privacy Preferences

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***Abstract*- E-Brainstorming is a computerized version of sharing ideas and it replaces verbal communication. The productivity of ideas generated is viewed as the dominant measure of E-Brainstorming. In Agent-based E-Brainstorming, Idea Ontology was used to map user's knowledge with idea names and relationships between idea instances. In this paper Oriented Directed Acyclic Graph (ODAG) method is used to construct the ideation map for diverse ideas and their relationship. Privacy Preference Ontology is integrated to provide privacy preference for user's data like access control, condition, access space and restriction. Here the Idea Knowledge Base is applied and it enfolds a collection of idea instances of different domains to denote a client's knowledge.**

***Index Terms*—E-Brainstorming, Intelligent agents, Privacy Preference Ontology (PPO), Oriented Directed Acyclic Graph (ODAG).**

I. Introduction

E-Brainstorming (EB) is a computerized format of sharing ideas and it replaces verbal communication.[7] This technique allows all the participants to contribute their ideas at same time and it effectively eliminates Production Blocking [6] and reduces Social Loafing. The productivity of ideas generated has been viewed as the dominant measure of E-Brainstorming. Briggs and Reining [2] provided a theoretical explanation in Bounded Ideation Theory to clarify the relationship between idea quantity and idea quality. They also recommended guidance for the development of ideation techniques for improving the quality [3] of ideas. A good idea was defined as one that is feasible to implement and would attain the goal.

Although brainstorming has become a popular group technique, researchers have not found evidence of its effectiveness for enhancing either quantity or quality of ideas generated. Because of such problems as *social loafing*, occurs when participants in a group feel unmotivated and they think their contributions will not be valued. *Evaluation apprehension*, occurs when individuals withhold their ideas out of concern that others may not approve them. *Production blocking*, occurs when something prevents a participant from verbalizing their ideas as they occur e.g. forgetting an idea while waiting for a turn to speak. Traditional brainstorming does not increase the productivity of groups, it may still provide benefits, such as boosting morale, enhancing work enjoyment, and improving team work. This system aims at incorporating a modified E-Brainstorming ideation model, which integrates Flexible ideation map construction for ideation rounds. In the existing system, tree like ideation map was constructed in which the SILA(Semantic Ideation Learning Agent) performed the associations with respect to a given idea and then generated their creative ideas and it was termed as Ideation Round. In this work, an efficient *Oriented Directed Acyclic Graph (ODAG)* method is used to construct the ideation map for diverse ideas and their relationship and ontology is improved to include privacy preferences [6]. This strategy provides privacy for all different groups. FOAF (Friend of a Friend) vocabulary retrieves the friends of a particular group. Access controller enables access restrictions e.g. read and write. This System works with intelligent agents based environment with privacy preferences and mapping is done with different domains areas. The agents are filtered and grouped according to their knowledge domain.

II. Brainstorming Techniques- Review

Brainstorming is a technique for generating a large number of ideas for creative problem solving. The term brainstorming was first used by [7]. The generation of new ideas, especially high quality creative ideas, is important for a problem. It is a popular method of group interaction in both educational and business sectors. *Brainstorming* engenders synergy i.e., an idea from one participant can trigger a new idea in another participant. Brainstorming has been recognized as an effective group decision supporting approach. Lin [4] developed brainstorming based multifunctional system which supports collaborating works on creative activity and decision making.

Most ideation research either implicitly or explicitly assumes Osborn's conjecture that if people generate more ideas, then they will produce more good ideas. Osborn reported evidence that people generate more good ideas in the second half of a brainstorming session than during the first half. Some studies have also reported that certain ideation protocols can elevate both idea quantity and idea quality. However, another work reported no relationship between idea quality and idea quantity. That is, previous ideation literatures were inconsistent in the arguments [10].

Briggs and Reining [2] provided a theoretical explanation (Bounded Ideation Theory) to clarify the relationship between idea quantity and idea quality, and they recommended guidance for the development of ideation techniques for improving the quality of ideas. A good idea was defined as one

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that is feasible to implement and would attain the goal. The Bounded Ideation Theory was a causal model of the ideation function (the relationship between the cumulative number of good ideas contributed during an ideation process and the total number of ideas generated). Their causal model identified three essential boundaries of human ideation capability (*an understanding boundary, a cognitive boundary and an endurance boundary*) that influence the production of good ideas.

The *understanding boundary* indicates that the relationship between the number of good ideas and the total number of ideas becomes a curvilinear function with a positive but decreasing slope once an understanding of the task has been achieved. The *cognitive boundary* signifies that because of the lack of additional external stimuli to activate a new part of the group memory, people tend to think inside the box, causing subsequent contributions to increasingly become similar to previous contributions, thus yielding fewer new good ideas (that is, the declining ratio of good ideas to the total ideas over time produces an ideation function with a positive but decreasing slope).

The endurance boundary signifies that because an individual's mental and physical abilities diminish with effort over time, ideation abilities will then decline as ideation proceeds (that is if the ideation process were to continue for a sufficiently long time, then participants might lose the ability to generate good ideas which leads to falling ratio of good ideas to the total ideas overtime and yields an ideation function with a positive but decreasing slope).

Although current e-brainstorming overcomes the spatial and distance limitation of conventional brainstorming with the technique of electronic communication, all participants must still be present at the brainstorming session at the same time to proceed with the discussion. With these advancements Soe- Tsyr Yuan and Yen-Chuan Chen [10] developed agent based ideation architecture and inference mechanism. To make an intelligent agent capable of generating ideas, the preliminary work investigates three fundamental human's association capabilities (*similarity, contiguity and contrast*) during idea generation, implements these capabilities in an agent's inference mechanism and unfolds the design of *SILA*, which performs idea associations based on a devised ontology-based representation of ideas. A *SILA* represents an ideation participant that can learn to understand the task and adopt external stimuli, free from limits in working memory and from attention exhaustion. Considering the aforementioned review of the brainstorming technique, this system aims at incorporating a modified agents based E-Brainstorming ideation model with an efficient *Oriented Directed Acyclic Graph (ODAG)* method used to construct the ideation map for diverse ideas and their relationship and ontology is improved to include privacy preferences Manju.S; Dr.M.Punithavalli (2012). This strategy provides privacy for all different groups. FOAF (Friend of a Friend) vocabulary retrieves the friends of a particular group. Access controller enables access restrictions e.g. read and write. This System works with intelligent agents based environment with privacy preferences and mapping is done with different domains areas. The agents are filtered and grouped according to their knowledge domain.

III. Ideation Map Construction

In the existing system, tree like ideation map was constructed in which the *SILA's* performed the associations with respect to a given idea and then generated their creative ideas and it was termed as Ideation Round. In the proposed model, an efficient *Oriented Directed Acyclic Graph (ODAG)* method is integrated to construct the ideation map for diverse ideas and their relationship [1].

A *graph* can be directed or undirected (no direction). Here an ideation map is constructed to improve both idea quantity and quality. Assume that, the given vertex as problem solving states or creative generated idea and arcs as the process of problem solving steps i.e. G= (V,A) will be represented as collection of vertices and the collection of directed arcs that connects pairs of vertices with no path returning to the same vertex. This is referred as *acyclic* graph.

The *ODAG* algorithm is based on two sets of data, the first set represents the vertices in a one dimensional array vertex (V) where each item in the array is annotated with the creative idea label (CIL), Round number (Rno), number of parents (Np), creative value (Cv) and Weight (W).The second set represents the arcs in 2-D array (V,V) where each item is annotated with the link 0 or 1 and the relationship is-a or part-of. In each round, the creative ideas are generated (parent) and it is allocated for generating creative idea instance in vertex (V), and adjacency (V, V).

The vertex with the highest creativity value (CV) in the previous round will be the initial states to the next rounds till the last rounds. Fig. 1 shows the generation of ideation map using *ODAG structure* i.e. process of all *SILA requestor*. Each ideation round has an input idea, as the association result. The initial idea is the input idea at round 1 and the creative ideas generated by SILA requestor in round 1(C1, C2, C3) is the input idea at round 2 etc. Hence, the ideation map can progressively be constructed through many ideation rounds. The process of "linking" among distributed knowledge has an extreme importance in creative thinking and problem solving. In this paper ideation map is constructed using acyclic graph structure which elevates maximum quantity and

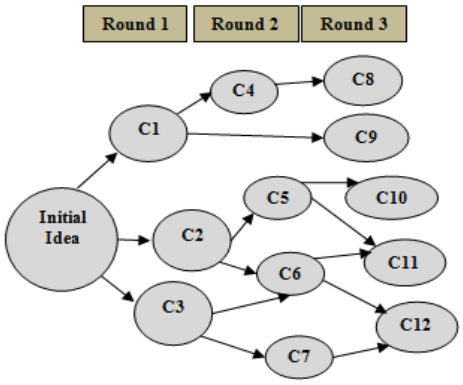

Fig.1. Ideation Map

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creative quality of ideas from each ideation round.

IV. Improved Ontology With Privacy Preferences

In Agent-based E-Brainstorming, *idea ontology* was used to map user's knowledge with idea names and relationships between idea instances. It provided minimum privacy settings such as granting privileges to all people belonging to one social group to access their information. In this paper *Privacy Preference Ontology (PPO)* [8] is used for participant to create fine-grained creative ideas. PPO is light weight vocabulary on top of the web access control *(WAC) Ontology* aiming to provide access control privileges for specific data like user's personal information. Villata; Delaforge; Gandon and Gyrard [9] described lightweight ontology which defines fine-grained access control policies for RDF data [5]. *FOAF (Friend of a Friend) vocabulary* is reused with agents to share private data with similar groups or friends [6].

E-Brainstorming methods so far have lack of privacy when sharing ideas across different organizations. An analysis of Brainstorming was done to gain more Knowledge about innovative idea generation. By introducing *PPO*, access control privileges could be introduced to the users for accessing data. *WAC (Web Access Control)* Vocabulary defines the read and writes access control privileges. Privacy preferences specify a protocol that enables the particular database profiles to share their privacy policies with users. The privacy policies are expressed in xml which can be easily parsed by user agents. The descriptions expressed using this protocol are text based and therefore do not contain any semantics. This approach enables users to define what the privacy preferences are about and hence facilitate other systems to use such preferences. A vocabulary that describes access control privileges is the *Web Access Control (WAC) vocabulary*. This vocabulary enables owners to create access control lists that specify access privileges to the users that can access the data.

The *WAC* defines the read and write access control privileges for reading (Or) updating data and control privilege to grant access to modify the access control lists. *Privacy Preference Ontology* is a lightweight vocabulary on top of the web access control ontology aiming to provide users with means to define fine grained privacy preferences for restricting access specific data. Semantic web technologies are used to enable privacy preferences. Open social networks can contain user's information using common vocabularies such as *FOAF* to describe the data.

Imagine a social group network where users could able to specify which information can be shared only to some contacts or friends i.e. the person's under social service. This would make user's feel more confident when publishing such information without being concerned that it could be reused. Such a system will let user's full control like who can access their personal information and who can access their published data. The data owners can specify a set of attributes which requestors must satisfy in order to be granted access to the requested information. For example a user can set a privacy preference to share an e-mail address with in friends group.

A. Privacy Preference Idea Ontology

Privacy Preference Ontology provides privacy preference for user's data like access control, condition, access space and restriction. Here the Idea Knowledge Base is applied and it enfolds a collection of idea instances of different domains to denote a client's knowledge. Privacy preference defines some properties to define, (1) which statement or resource is to be restricted. (2) Define conditions in order to create specific privacy preferences [8]. (3) Some properties to define which access privilege should be granted for accessing client's data base.

Using access control read and write authority is included for accessing the knowledge base. For all authenticated user's read and write access control is included. Condition is applied to resource, class, literals and property. Access space is applied to all queries and restriction is applied to resources and statements.

B. Privacy Preferences

In social network, Web ID protocol can be used to authenticate a user and it provides a secure connection to a user's personal information stored in a FOAF profile. In Fig.2 shows idea ontology to grant privileges to user's belonging to one social group and provide access control restrictions for user's personal data.

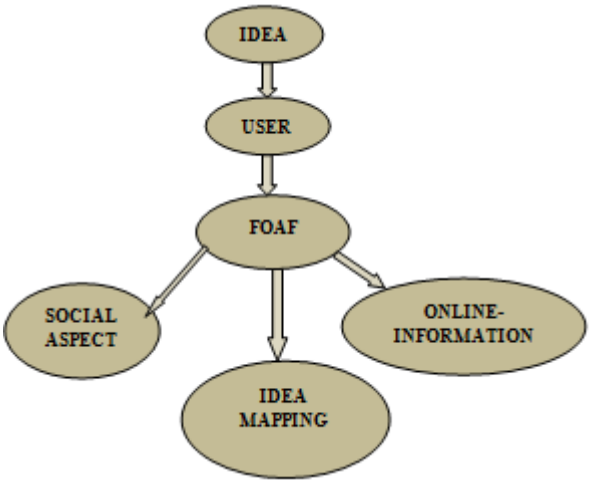

Fig. 2 Idea Ontology

When a user authenticates using Web ID and to visit another user's profile, the privacy preferences could be checked to determine which information can be accessed. This vocabulary has ability to restrict access to, a particular statement, to a group of statements and to a resource, either as a subject or an object of a particular statement. Access is restricted according to patterns which users must satisfy, for instance having a particular interest or being a member of a group.

The fig.3 (a) illustrates that wherever in the user's profile there is a statement that contains a property foaf: company Documents then all statements containing this property are restricted.

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```
A PPO: PrivacyPreference;
PPO: hasCondition
[
PPO: hasProperty foaf: Company
Documents
];
PPO: hasAccess acl: Read;
PPO: hasAccessSpace
].
```

Fig.3 (a) example 1 Privacy Preferences

The fig.3 (b) illustrates privacy preference to statement with read access control and restricted write control for user's address details. Thus the privacy preference with access control privileges will be granted and a space to define which attributes a requestor must satisfy in order to access the resources.

```
A PPO: PrivacyPreference;
PPO: appliesToStatement
PPO: assignAccess acl: Read;

PPO: hasCondition
[
PPO: hasProperty: address details;
].
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Fig.3 (b) example 2 Privacy Preferences

V. Result & Discussion

The maximum quantity of ideas is increased using Neural Network based agents in E-Brainstorming.

For.eg. In a sample Indian company's data set Neural Network is trained to achieve the maximum iterations and results. In Fig.4 Neural Network is trained with tan-sigmoid transfer functions in both the hidden layer and output layer. For a sample approximately 20 neurons were used in one hidden layer. The network has two output neurons, because of categories associated with input vector. When an input vector of the appropriate category is applied to the network, the corresponding neuron should produce 1 and the other neurons should produce output as 0.

A Default scaled conjugate gradient algorithm is used for training. The application randomly divides the input vectors and target vectors into three sets. 60% for training, 20% for validating the network and remaining 20% is used as completely independent test of network generalization.

The Proposed work advances the existing agent based E-Brainstorming by increasing the scope of ideation ontologies by including privacy preferences. This strategy provides privacy for all different groups. FOAF (Friend of a Friend) retrieves the friends of a particular group and agent with similar domain. Access controller enables access restrictions e.g. read and write. This system also reduces the complexity of idea mapping by using Oriented Directed Acyclic Graph

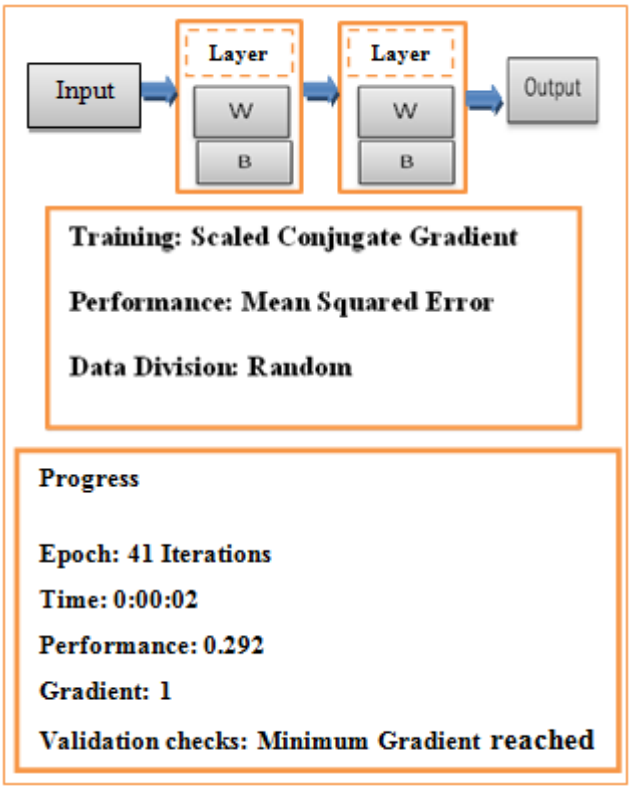

Fig.4 Neural Network Training

for diverse ideas and their relationship. Furthermore, ideation map constructed using acyclic graph structure elevates maximum quantity and creative quality of ideas from each ideation round.

VI. Conclusion & Future Work

This paper aims at incorporating a modified E-Brainstorming ideation model, which integrates Flexible ideation map construction for ideation rounds. In the existing system, tree like ideation map was constructed in which the SILA(Semantic Ideation Learning Agent) performed the associations with respect to a given idea and then generated their creative ideas and it was termed as Ideation Round. In this work, an efficient *Oriented Directed Acyclic Graph (ODAG)* method is used to construct the ideation map for diverse ideas and their relationship. This also presents the effective method of E-Brainstorming with security for the users' data. The Agents are linked with social web ontology for ensuring privacy preferences. The new Agent-Based PPO Model is derived by integrating FOAF Ontology. The access control mechanisms are carried out and a FOAF Ontology is reused here to restrict access to the controlled group of users. The existing methods do not follow any criteria for secure transformation of user's personal information.

Future work will incorporate new association techniques, Modified Neural network based agents and implementing this model with device based environment e.g. smart phones.

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